

Chapter Title: Species Management
Section Title: Muskellunge Management
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I. PURPOSE

The purpose of this section is to guide fisheries staff in the management of muskellunge throughout the state. The section provides background information on muskellunge in Wisconsin, a description of the muskellunge resource, management goals and objectives, standard management practices, and assessment criteria used to evaluate standard survey data.

II. DEFINITIONS

III. POLICY

Section NR 1.01, Wis. Admin. Code; ss. 23.09 and 29.014, Wis. Stats.

IV. PROCEDURES

- A. BACKGROUND - Designated as the state fish in 1955, muskellunge are found in lakes of all sizes and in the slower waters of large rivers, usually occupying areas with abundant submerged aquatic plants. The heart of the range is north central Wisconsin, although they are found throughout the state; nearly 90% of muskellunge waters occur in the northern third of Wisconsin. Muskellunge are the largest predatory game fish found in Wisconsin. They are known to feed on virtually every fish species, as well as aquatic birds and mammals (Bozek et al. 1999). Muskellunge are usually present at low densities, with most waters generally containing less than 1 adult per acre. A [fact sheet](#) with common information is available.

The muskellunge is managed as a trophy fish species in Wisconsin, so angler harvest is usually restricted through relatively high length limits and low daily bag limits to promote the occurrence of large fish in the population. Only hook and line fishing is allowed for muskellunge. Restrictions on trolling (originally developed to reduce muskellunge harvest) also exist in many waters throughout the state. Fishing regulations for muskellunge are varied, depending upon the growth potential of the population and public support for high length limits. The current statewide minimum length limit of 40", with a daily bag limit of 1, applies to approximately 94% of all muskellunge waters (see [Harvest Regulations](#), below, for a more detailed breakdown of length limits). The daily bag limit for muskellunge is generally 1 on all waters statewide, except Yellowstone Lake, Lafayette County (daily bag limit is 0), and Escanaba Lake, Vilas County (no daily bag limit). The open season for muskellunge north of US Hwy. 10 (Northern Zone) is from the Saturday nearest Memorial Day to November 30, except on Escanaba Lake, Vilas County, which has a continuous open season with no size limit or daily bag limit. The open season south of US Hwy. 10 (Southern Zone) is from the first Saturday in May to December 31. A variety of fish refuges designed to protect vulnerable concentrations of spawning muskellunge exist throughout the state. Natural reproduction has always been relatively

low and has been presumed to be declining, making stocking an important management strategy in some waters, especially for populations that are totally dependent on continued stocking. The economic impact of muskellunge fishing in Wisconsin is substantial. A 2006 US Fish and Wildlife Service report estimated that 1.4 million anglers fishing in Wisconsin spent \$1.7 billion on fishing (fishing trips, equipment, etc.). About 25% of anglers fish for muskellunge. So, about 5.3 million angler-days are spent fishing for muskellunge each year. A rough estimate of expenditures would be \$425 million spent directly on muskellunge fishing in Wisconsin. This does not include indirect economic impacts, such as wages and tax revenue.

- B. RESOURCE BASE - Muskellunge occur in 667 lakes (588,852 acres) and 100 segments on 48 rivers (2,085 miles; [Simonson 2012](#)). Not all waters containing muskellunge are necessarily classified as "musky waters". Muskellunge waters are divided into 3 classes of angling quality, based on the relative abundance and size-structure of the muskellunge population (Simonson 2012; Simonson and Hewett 1999; see CLASSIFICATION, below):

Class A waters are the premiere muskellunge waters, considered by most to provide the best muskellunge fishing. These are divided into two distinct classes:

Class A1 - These waters are best known as "trophy waters" for their ability to consistently produce a number of large muskellunge, but overall numbers of muskellunge may be relatively low. Angling action can be inconsistent in these waters, but fish that are caught have a larger average size. At certain times when conditions are right, however, these waters can also provide good action (122 lakes, 254,838 acres; 13 river segments, 170 miles).

Class A2 - These waters are best known for providing the most consistent angling action, and some may have the potential to produce big fish, as well. They generally have the best overall numbers of muskellunge, but big fish make up a smaller percentage of the total, compared to the Class A1 waters (194 lakes, 70,249 acres; 16 river segments, 262 miles).

Class B - This intermediate class consists of waters providing good fishing but, in general, angler success and catch rates may be somewhat less than in prime Class A waters (227 lakes, 226,606 acres; 39 river segments, 1014 miles).

Class C - These waters have muskellunge present, but they are of minor importance in the overall statewide fishery (124 lakes, 37,129 acres; 32 river segments, 639 miles).

Muskellunge waters are further divided into four categories that described the reproductive status of the population, based on the level of natural production and the extent to which muskellunge are stocked. This categorization is important to when considering management options for waters. Obviously, having all waters self-sustained by natural reproduction would be ideal, but stocking is

often required to either supplement natural populations or to sustain a fishery. Categories of reproductive status are as follows:

Category 1 - The population is self-sustained through natural reproduction. No stocking occurs.

Category 2 - The population has some natural reproduction, however some stocking occurs to supplement natural recruitment.

Category 3 - The population has no known natural reproduction of muskellunge. Stocking of muskellunge is required for maintenance of a population.

Category 0 – The population has no known natural reproduction or stocking. Muskellunge are present, due primarily to immigration from connected waters.

- C. MANAGEMENT GOALS - The goals and objectives of muskellunge management are as follows. An ongoing evaluation of these goals is provided in a separate document, [Muskellunge Management Update](#) (PUBL FH-508), available at the [Wisconsin Musky](#) web page.
1. Protect and enhance Wisconsin's naturally reproducing (category 1) populations.
 - a. Identify self-sustained muskellunge populations.
 - b. Identify and protect existing spawning and nursery habitat. Utilize the Nohner GIS model to identify potential spawning grounds.
 - c. Protect the genetic integrity of self-sustained muskellunge populations.
 - d. Protect adult muskellunge from harvest to full maturity.
 2. Manage muskellunge for a variety of unique fishing opportunities (including trophy, quality action, and harvest) within balanced aquatic communities.
 - a. "Trophy Fisheries" - Manage Class A1 waters to increase the catch of 45" and larger muskellunge, with some fish larger than 50".
 - b. "Action Fisheries" - Manage Class A2 waters for a catch rate of 1 muskellunge (any size) per 25 hours of direct angling effort.
 - c. Harvest-oriented Fisheries - Maintain a limited number of high density, slow-growing Class A2 populations as unique harvest opportunities.
 - d. Improve Existing Fisheries - Rehabilitate former muskellunge waters that have experienced substantial declines in the muskellunge population; improve class B and C fisheries, particularly in southern Wisconsin.
 3. Improve the information available for muskellunge populations and educational efforts to inform anglers about the status and management of muskellunge fisheries.
 - a. Monitoring - Assess muskellunge abundance, size-structure and associated fish communities. Maintain updated Class and Category designations. Conduct a survey every 10 years to track angler attitudes and evaluate program goals. Develop a pilot Angler Diary program.

- b. Evaluation – Assess muskellunge regulations; evaluate stocking to determine relative contribution of stocked fish in category 2 waters and success in category 3 waters.
 - c. Education - Provide information and technical assistance to our partners, anglers, and lakeshore property owners. Continue to emphasize the value of catch and release. Emphasize the role that muskellunge play within aquatic ecosystems, including interactions with other species.
- 4. Minimize User conflicts - provide a unique, aesthetically pleasing experience.
- d. MANAGEMENT PRACTICES - A number of management practices are available to assist with reaching the goals of muskellunge management, including habitat protection and improvement, fishing regulations, stocking, monitoring, and education.
 - 1. Habitat Protection and Improvement - Good water quality and appropriate physical habitat are essential to the long-term viability of muskellunge in Wisconsin. Significant muskellunge spawning grounds should be documented and inventoried to ensure proper protection (for specific procedures used to identify musky spawning areas, for both staff and volunteers, see [Musky Spawning Survey](#)). Fisheries staff must continue to make careful, informed recommendations regarding shoreline development, aquatic plant management, and Chapter 30 decisions, along with participation in [Critical Habitat designation](#) procedures. Work with local units of government to encourage adequate ordinances that protect identified critical habitat areas. Acquisition of lands adjacent to spawning grounds or other critical habitat features (e.g., nursery areas) may be warranted. Finally, encourage riparian land owners to adopt [fish-friendly practices](#) along shorelines. Water levels that encourage natural spawning should be promoted. Lowering water levels in fall and winter to desiccate spawning areas may promote increased egg survival. Exposing these sediments to air will reduce biological oxygen demand and increase oxygen concentrations at the sediment-water interface. Also, water levels over spawning areas must be sufficient during the spawning period. Very little is known about improving habitat for muskellunge. Several potential practices are available but are in need of evaluation.
 - 2. Harvest Regulations - Generally, regulations are designed to promote the trophy aspect of muskellunge fishing. This requires that the fish be large and relatively rare. Length limits should be large enough to promote the trophy character of the species and take full advantage of its growth potential. While angler harvest of muskellunge is very limited, even modest exploitation can impact the size-structure of populations. Therefore, in order to sustain the number of large fish, exploitation on all sizes must be low. The growth potential of muskellunge populations varies from water to water. Lake size (acres) explains nearly 70% of the variation in ultimate length among lakes. The statewide 40" minimum length limit matches the growth potential of the vast majority of Wisconsin waters. Class A1 waters, with their excellent growth potential, are more intensively managed for trophy fishing opportunities. These are generally some of our largest lakes – the predicted average “ultimate length” exceeds 50” on lakes 2000 acres and larger. Target values for these waters are: $PSD_{38} \geq 30$; $PSD_{42} \geq 17$; density $< 0.3/\text{acre}$; $L_{inf} \geq 48"$;

omega ($L_{inf} * K$) > 8"/year. There are certain other waters that have naturally high densities of muskellunge and relatively poor growth potential. These lakes are regulated using relatively liberal angling restrictions (28" minimum length limit); they are unlikely to provide trophy angling, but are often important "action" waters. These are generally self-sustained, high-density, slow-growing Class A2 populations; adults generally do not exceed 38" (in some cases, few fish exceed 30"); the inability to produce 40"+ fish is generally related to lake characteristics (e.g., small, shallow, weedy lakes, usually < 300 acres) or genetic predisposition to small body size, not fishing pressure or harvest. Density > 0.6/acre (75th percentile); mean length at age 6 < 30" (lower 20th percentile); or PSD₃₈ < 5 (10th percentile); PSD₄₀ or PSD₄₂ = 0.

Framework for muskellunge length limits on Wisconsin's 715 muskellunge waters

Musky Population Status	Minimum length limit	Number of waters	Approximate % of Musky waters
High density, slow growing populations, few fish exceed 30"	28"	21*	3%
Moderate density, moderate growth potential; most fish capable of exceeding 40"	40"	674	94%
Trophy potential, based on growth and/or historic information; brood stock lakes	45 or 50"	20**	3%

*Includes Escanaba Lake, Vilas County, which has no minimum length limit. **Includes waters with a 45" minimum length limit (7 waters), a 50" minimum length limit (12 waters), and Catch-and-release only (1 water).

A complete listing of the fishing regulations, including a searchable database, is available on the web at [Fishing Regulations Booklet](#).

3. **Stocking** - Stocking is a key element in the management of many muskellunge waters. Stocking is generally used as part of an integrated approach, which also considers habitat protection, restoration or improvement, harvest regulations, public access, and public education and involvement. At present, approximately 178 waters (25% of Wisconsin's 709 muskellunge waters) are regularly [stocked with muskellunge](#) to supplement or maintain the fishery. From 2000 to 2009, an average of 53,326 large fingerlings was stocked every year in inland waters. Stocking should be used to accomplish specific objectives for the waterbody through one of the following strategies (see **STOCKING CHAPTER**, for definitions and procedures):

- a) **REHABILITATION (Priority 1):** Re-establishment of populations reduced by catastrophic natural or intentional sources of mortality. Waters – Winter-kill lakes should only be

stocked if serious mortality occurs less frequently than once every 15 years, unless a plan to minimize the risk of future winter-kills is developed and approved.

- b) **BROOD STOCK LAKES (Priority 1):** Brood Stock lakes may be stocked in years when eggs are taken from that lake. The stocking rate (quota) is determined by the biologist.
- c) **RESEARCH or EVALUATION (Priority 2):** Experimental stocking done in conjunction with a research or evaluation project. Stocking sizes and frequencies as needed to realistically meet the objectives of the evaluation project, approved and funded through the normal FM workplanning process (or Science Services process).
- d) **REMEDIATION OR RECREATION (MAINTENANCE) (Priority 3):** Waters - Based on Fields et al. (1997), stocking should generally not occur in waters with adequate natural reproduction, in order to minimize the potential negative impact of stocked fish on naturally reproducing populations in the receiving or connected waters (Goal I. C). An average fall electrofishing catch rate of at least 0.5 YOY/mile is normal for muskellunge in naturally reproducing waters (and ranges from 0.1-1/mile). Further, no stocking quotas should generally be developed for Class A2 lakes less than 200 acres in size or for Class A1, B, or C lakes less than 500 acres in size. Source of fish should be specified as the appropriate basin stock, unless the water is outside the native range of muskellunge. Generally, large fingerlings should be stocked in alternate years. If the fishery objective (e.g., adult density, catch rate, etc.) is not met, discontinue stocking until action is taken to identify and correct the reason(s) for poor survival.
- e) **INTRODUCTIONS (Priority 4):** Waters - New introductions of muskellunge are not authorized without an Environmental Analysis. Even then, limited availability of fingerlings from the hatchery system severely limits the ability to add new muskellunge waters that will require ongoing maintenance stocking. Only large waters (>3,000 acres) with the potential for good growth should be considered.

Purpose	Priority	Musky Class	Life Stage	Stocking Frequency	Maximum Stocking Rate	Maximum per waterbody per Tier	Objective (adults/acre)
Rehabilitation	1	All	Fry	First year of Rehabilitation	500/acre	100,000	--
		All	Large Fingerling	Annual for 4 years, then Maintenance	2/acre	2,500	--
Brood Lakes	1	All	Large Fingerling	Only when eggs are taken	2/acre	None	--
Research	2	All	As needed	As needed	As needed	As needed	As needed
Maintenance	3	A1, B	Large Fingerling	Annual	0.5/acre	2,500	0.1 – 0.3
Maintenance	3	A1, B	Large Fingerling	Alternate	1.0/acre	2,500	0.1 – 0.3
Maintenance	3	A2	Large Fingerling	Annual	1.0/acre	2,500	0.3 – 1.0
Maintenance	3	A2	Large Fingerling	Alternate	2/acre	2,500	0.3 – 1.0
Introduction	4	All	Large Fingerling	Annual for 4 years, then Maintenance	2/acre	2,500	--

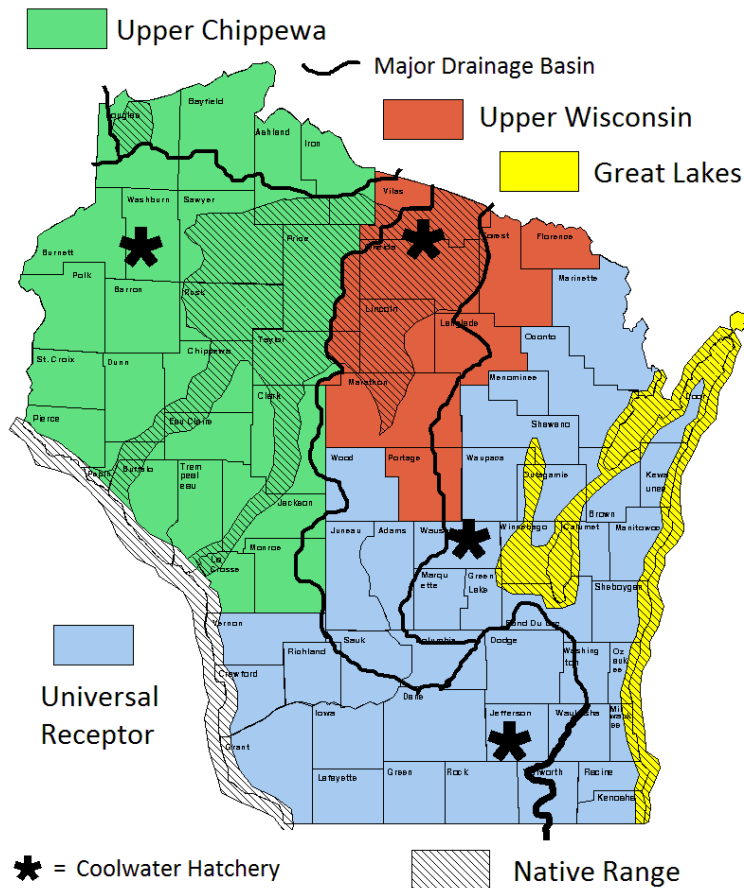
Under our current [Brood Stock Management Plan](#), the following Basin Stocks are available (see also, map, below):

Basin Stock name:	Suitable for the following inland waters:	Suitable for the following outlying waters:
Upper Chippewa River	Chippewa R., St. Croix, L. Superior inland waters, Black River; Universal Receptors*	N/A
Great Lakes Spotted	Lake Winnebago System and downstream via the Fox River to De Pere dam; Inland Brood Stock Lakes	Green Bay, Lower Fox River, Lake Michigan and Lake Superior^
Upper Wisconsin River	Wisconsin River and L. Michigan inland basins; Universal Receptors*	N/A

* "Universal Receptor" waters are outside the native range of muskellunge that are dependent on stocking.

^ Once a secure inland brood source is established, Great Lakes Spotted muskellunge should be stocked in inland waters of the Lakes Michigan and Superior basins.

Muskellunge Genetic Management Zones - Current



Special considerations:

- 1) Stocking requests should be submitted up to the full “biological quota” (the selected stocking rate*lake acres), even if you don’t think the propagation system will be able to meet the need, or the request is for a product that is not approved (e.g., yearlings). This provides an accurate measure of demand from the propagation program for new and existing products, and assists with long-term infrastructure planning. Every effort will be made to evaluate requests for existing products and the demand for new products. If possible, the propagation program will attempt to produce all requested fish, either via our hatcheries, with cooperative agreements, or from other State, Federal, or Tribal agencies. We also provide lists of unmet or deferred needs to private aquaculture.
- 2) Regardless of the full biological quota requested, waters are typically “capped” at a maximum of 2,500 large fingerlings per year in order to spread out available production across many waters. This generally does not include Brood Stock lakes because they are only stocked every 3 years.
- 3) The full biological quota will be used to fill quota requests in the event of surplus fish and it will be used to determine the number of cooperatively reared or club-purchased fish that may be stocked above the cap. If surplus fish are available, a “tier system” will be applied. Under the first tier, all waters will receive requested quotas (up to a maximum of 2,500). Then, under the second tier, any waters capped at 2,500 under the first tier will receive fish up to the full “biological” quota (or, a maximum of 5,000, total, whichever is smaller). Finally, any waters capped at 5,000 under the first and second tiers will receive additional fish, up to the full “biological” quota (or a maximum of 7,500, total) under the third tier.
- 4) In general, muskellunge stocking quotas should remain constant from year to year, in order to provide a fixed target for the production system and to provide a better means of evaluating the long-term contribution of stocked muskellunge. However, this should be an adaptive process, and quotas may be changed when good data are available to justify it.
- 5) No stocking quotas should be submitted for current brood stock lakes (except in years when that lake is used as a brood source, if needed): Upper Chippewa River Basin – Chippewa Flowage, Lost Land and Teal Lakes, Lac Courte Oreilles, Sawyer County. Upper Wisconsin River Basin - Big and Little Arbor Vitae Lakes, Vilas County; Minocqua Chain, Oneida County; Pelican Lake, Oneida County; Squirrel Lake, Oneida/Vilas Counties (alternate).

- 6) Muskellunge stocking quotas should not generally be developed for Class A2 waters less than 200 acres. For Class A1 waters, a minimum lake size of 500 acres is recommended. These guidelines are NOT retroactive. However, quota requests should be critically reviewed based on muskellunge density, fishing effort/angler use, and distance from the hatchery; please consider removing smaller waters from the stocking plan, where appropriate.

4. Information and Education - Although much is known about muskellunge, additional information is needed to fully realize the management goals. Data on the catch, harvest and effort directed at muskellunge is currently being obtained the in heart of the range, but much less information is available from stocked waters in the southern half of the state. Additional creels surveys should be conducted on important southern waters. We have accumulated considerable information on the relative abundance and size-structure of many muskellunge populations. A long term evaluation of stocking is underway and should be completed soon. There is a need for better information on age and growth of muskellunge, as well as recruitment in stocked and NR fisheries, spawning behavior (site fidelity) relative to brood stock objectives, and an evaluation of methods for conducting population estimates. Support for the propagation program related to brood stock management and an evaluation of our stocking practices and framework are also priorities. In light of continuing challenges with the cost and bio-security of live forage, we should consider evaluating muskellunge reared on an artificial diet, and also evaluate specific situations where eggs, fry or small fingerlings may work. A program that involves volunteer anglers in both angler catch rates and age and growth (using PIT tags) should be pursued. Further research is also needed on spawning habitat, and whether we can create or improve it. It would also be valuable to study lakes with natural reproduction to determine key factors related to good natural recruitment.

5. Monitoring - In addition to the standard sampling procedures (Inland Fisheries Surveys section, Surveys and Investigations Chapter), there are specific procedures for estimating adult muskellunge abundance, which also includes estimating three other parameters: length-frequency histograms (PSD), relative weight (W_r), and growth. Adult muskellunge are captured in two consecutive years (Hanson 1986) using standard fyke nets during the spring spawning period (SN II). Electrofishing may be used to supplement the capture of muskellunge for population estimates, but fish sampled by electrofishing should not be included in length-frequency histograms. If SN I is being conducted for other species, you should also mark muskellunge during this period (and include them in length-frequencies). Attempt to mark 10% of the estimated population or 1 fish per 10 surface acres. Muskellunge are measured, weighed, and marked with a half pelvic or pectoral fin-clip (other marks/tags may be used if adjustments are made for tag loss). Weights should be taken on as many muskellunge as feasible, as time permits. During the marking period, muskellunge < 30 inch are given a different clip to aid in adjusting for recruitment of fish that grow into the 30"+ range during the recapture period. Attempt to determine sex; fish that cannot be classified (unknowns) are considered mature if

they are as long as the smallest sexually mature female for that water, or 30 inches or longer. Muskellunge captured during the first year make up the marking run, and those from the second year make up the recapture sample. Numbers in the recapture sample are adjusted for recruitment over the 1-year period using sex-specific and lake-specific growth rates, based on marked fish < 30". [For populations with a considerable portion of adult fish smaller than 30 inches, the number of muskellunge 30 inches or longer is determined by multiplying the proportion of muskellunge 30 inches or longer handled in the marking sample times the abundance estimate for mature fish 20 inches or longer].

Abundance of adult muskellunge (≥ 30 inches) is estimated using Bailey's modification of the Petersen single-census method (Hanson 1986):

$$N = M(C + 1)/(R + 1)$$

where N = population estimate; M = the number of fish marked in the first sample; C = the total number of fish (marked and unmarked) captured in the second (recapture) sample; and R is the number of marked fish captured in the second sample.

For more information on adult muskellunge sampling protocol, see Cornelius and Margenau (1999) and Margenau and AveLallemant (2000).

Standard Sampling Procedures, by water types - Sampling methods are selective for certain species and sizes. Using the appropriate method is important to maximize the information collected and provide comparable results across waters. The table below describes the standard sampling methods recommended for each important fish species or group of species in Wisconsin.

Waters	Metrics	Period	Temp. Range	Gear	Procedures
Lakes	CPE, PSD, PE	Spring Netting I (if also walleye netting; AND Spring Netting II	Ice out to 40-50 F; 50 - 55 F	4'x6', 3/4" bar mesh	length/weight/sex/age; mark/recapture
Lakes	Juvenile CPE, age (NR or potential NR lakes)	Fall Electrofishing	50 - 65 F	Boom shocker, 3/8" mesh dip nets	length/weight/age all muskellunge < 20"
Non-wadable Rivers	CPE, PSD	Summer		Boom shocker or mini-boom	length/weight/age

Aging – See “**Estimation of Fish Age and Growth**” in the **Surveys and Investigations Chapter**.

6. Muskellunge Waters Classification – The classification and category of muskellunge waters should be reviewed and updated, if needed, as a result of each survey. In addition to the [definitions](#) of the classes and categories provided earlier in this section, the following additional guidelines will help determine the appropriate class and category of most waters.
 - a) Class "A1" waters are trophy waters managed for exceptional population size-structure. Class A1 should generally NOT be used for waters less than about 1,000 acres. Instead, smaller waters managed for low to moderate density and good size-structure are more appropriately Class "B" waters.
 - b) Class “A2” waters are typically high density, slower growing populations
 - c) Class “C” waters are waters where muskies are present, but no real fishery exists and no plans exist to improve the population. Class "C" that have been dependent on stocking and where the status has not changed for approximately 10 years could be dropped from the Muskellunge Waters listing. Class “C” should rarely be a management goal for musky waters. It is reserved primarily for waters connected to other managed muskellunge waters.
 - d) Classifications should generally be consistent among lakes within a chain where movement of fish is not restricted.
 - e) Reproductive category should be based on actual stocking records.
 - f) Category 1, self-sustained, generally means that fall YOY catch rates average at least 0.24/mile (normal range: 0.0 – 0.53/mile); that several sizes/ages of fish are present when no stocking occurs; and the population abundance falls within an acceptable range in the absence of stocking (0.14 – 0.52/acre).
 - g) Waters that haven’t been stocked for several years should either be category “1” or category “0”.
 - h) Category "0" is generally be reserved for waters with NO reproduction and NO stocking, but with some muskellunge present via connection to other stocked or NR waters; do not use category “0” for “unknown”.
7. Assessment Criteria – Muskellunge population metrics should be compared similar waters. The muskellunge classification has proven to be an important factor in differentiating populations. The following tables provide the normal ranges of common metric values for muskellunge waters.

Normal range of spring muskellunge CPE (number/net-night) values (2000-2011), by muskellunge classification

Musky Class	CPE (muskies/net-night)			N
	First Quartile	Median	Third Quartile	
A1	0.25	0.42	0.73	110
A2	0.38	0.74	1.50	156
B	0.15	0.32	0.64	121
C	0.05	0.12	0.35	62
Overall	0.19	0.41	0.87	468

Normal range of muskellunge abundance (number/acre) values (2000-2010), by muskellunge classification

Musky Class	PE (muskies/acre)			N
	First Quartile	Median	Third Quartile	
A1	0.09	0.14	0.22	32
A2	0.27	0.50	0.70	38
B	0.17	0.30	0.39	23
Overall	0.15	0.26	0.50	93

Normal ranges of muskellunge PSD values (2000-2011), by muskellunge classification. Stock size is 30" and larger.

Musky Class	PSD _{38/30}			N
	First Quartile	Median	Third Quartile	
A1	23	38	54	96
A2	17	29	41	108
B	27	38	50	59
C	13	46	60	19
Overall	21	33	50	282
	PSD _{42/30}			
	First Quartile	Median	Third Quartile	
A1	5	13	23	96
A2	2	7	14	108
B	4	11	18	59
C	0	13	25	19
Overall	3	9	18	282
	PSD _{45/30}			
	First Quartile	Median	Third Quartile	
A1	3	6	10	102
B	0	2	6	52
Overall	0	4	8	154

Normal range of fall juvenile muskellunge ($\leq 20''$) CPE (number/mile) values (2000-2011), by reproductive category

Musky Category	CPE (muskies/mile)			N
	First Quartile	Median	Third Quartile	
0	0.00	0.16	0.71	15
1	0.00	0.24	0.53	117
2	0.13	0.44	0.89	263
3	0.00	0.37	1.00	175
Overall	0.00	0.36	0.83	570

Normal range of fall juvenile muskellunge ($\leq 20''$) CPE values (number/mile) values (2000-2011), by muskellunge classification.

Musky Class	CPE (muskies/mile)			N
	First Quartile	Median	Third Quartile	
A1	0.12	0.27	0.88	135
A2	0.21	0.49	1.00	210
B	0.00	0.37	0.79	149
C	0.00	0.17	0.50	76
Overall	0.00	0.36	0.83	570

e. REFERENCES

Bozek, M.A., T.M. Burri and R.V. Frie. 1999. Diets of muskellunge in northern Wisconsin lakes. North American Journal of Fisheries Management 19:258-270.

Cornelius, R. R., and T. L. Margenau. 1999. Effects of length limits on muskellunge in Bone Lake, Wisconsin. North American Journal of Fisheries Management 19:300-308.

Hanson, D.A. 1986. Population characteristics and angler use of muskellunge in eight northern Wisconsin lakes. Pages 238-248 in G.E. Hall, editor. Managing Muskies. American Fisheries Society, Special Publication 15. Bethesda, MD.

Margenau, T.L., and S. P. AveLallemant. 2000. Effects of a 40-inch minimum length limit on muskellunge in Wisconsin. North American Journal of Fisheries Management 20:986-993.

Simonson, T.D., editor. 2012. Wisconsin Muskellunge Waters. Wisconsin Department of Natural Resources. Publication FH – 515.

Simonson, T.D. and S.J.Hewett. 1999. Trends in Wisconsin's muskellunge fishery. North American Journal of Fisheries Management 19:291-299.

V. HISTORY

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VI. APPROVAL

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